Physico-Chemical and Bacteriological Assessment of Potable waterof Agra and its Bioremediation

SYNOPSIS

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INTRODUCTION

Water, is the most basic and absolutely essential component for life. The average adult human body is 50-65% water while its percentage is much higher in infants, typically around 75-78% water. Our major concern is to know whether the water that we are consuming is safe, or not, because the quality of water has deteriorated largely due to contaminated source, treatment failure (partial/total), recreational water exposure, etc. (Bain *et al*., 2014(a); Bain *et al*., 2014(b); Goel *et al*.,2015; Chaudhuri and Roy, 2016) and its contamination is affecting a larger population(WHO, 2007). Some of the water borne diseases are Cholera, Diarrhoea,Typhoid, etc. Among all water borne diseases, diarrhoeal diseases are of a major concern because they cause morbidity and mortality in large numbers in the developing countries.

In India, diarrhoea is the third most common cause of death in children under-five years of age causing 13% deaths in this age-group, killing an estimated 300,000 children each year (Bassani, 2010). Information on diarrhoeal diseases, its determinants in India and preventive and control strategies in light of recent developments need to be reviewed for better planning and organization of health services within the community.India has made steady progress in reducing deaths in children younger than 5 years, with total deaths declining from 2.5 million in 2001 to 1.5 million in 2012 (Bhan, 2013) This reduction was possible due to the inception of many universal programs like expanded program on immunization, program for the control of diarrhoeal diseases and acute respiratory infection. Nevertheless the proportional mortality accounted by diarrhoeal diseases still remains high. In the past, several outbreaks of diarrhoeal diseases have been reported all across the nation (Verma *et al.*,2012; Pardeshi and Doibale 2012)

The microbes which are mainly responsible for diarrhoeal illness are the bacterial pathogens which include *Escherichia coli, Shigella, Salmonella, Campylobacter, Yersinia, Aeromonas,*etc., of these *Escherichia coli*and their different pathotypes are of great importance (Presterl, 2003). Five major classes of diarrhoeagenic *Escherichia coli* (DEC) are associated with diarrhoeal diseases. These are:

enterotoxigenic *E. coli* (ETEC), enteroinvasive *E. coli* (EIEC), enteropathogenic *E. coli* (EPEC), enterohaemorrhagic *E. coli* (EHEC), and enteroaggregative *E. coli* (EAEC) (Hart, 1989;Presterl, 2003).

There are several drugs used to treat bacterial infection due to water but resistance is commonly seen to occur (Presterl, 2003). Bio-remediation is a natural technique, which is very effective to treat the problems at the root level (Azubuike, 2016). By choosing an appropriate bioremediation technique which can effectively thephysico-chemical status and bacteriological load in the drinking water is crucial for an effective control. In the proposed study both natural product and probiotics will be employed to effectively the physico-chemical status and the bacteriological contamination, if any in the water samples.

AIM OF THE STUDY

The aim of the study is to analyze the quality of drinking water seasonally of Agra. This quality can be attributed to the bacterial communities present and the physico-chemical properties of the water. These parameters directly affect human health. Therefore, measures to remediate the harmful bacteria and to improve the physico-chemical status of the drinking water shall be investigated.

REVIEW OF LITERATURE

Khaiwal*et al*.,(2003) "studied the seasonal variations in the phsico-chemical characteristics of the river Yamuna in Haryana and analyzed the co-relations between the different factors. They found that DO and TDS are the two important factors which are strongly co-related with other parameters". Skrodenyte *et al*., (2006)"explored the microbial diversity of the intestinal microbiota of the *Salmo trutta fario* by 16S rRNA gene sequencing techniques". Mudur (2006) "published a report in NCBI of the governmental survey in which they found that about 4 lakh to 5 lakh children under five years of age die annually from diarrhoea". WHO (2007) "provided the annual statistics of the water borne diseases at household levels across the world. According to this, in developing countries diarrhoea occupies a leading position among the water borne diseases as the cause of death and illness, killing 1.8 million and causing approximately 4 billion cases of illness annually. Children suffer the most from diarrhoea, nearly 90% of diarrhoeal deaths occur in children under the age of five".

Nasir *et al*., (2007) "investigated the efficacy of modified distillation sludge of rose (*Rosa centifolia*) petals for the removal of heavy metals like- lead (II) and zinc(II) from aqueous solutions". Gillor *et al*.,(2008) "studied the probiotic applications of lactic acid bacteria and analyzed the dual role of bacteriocins as anti and probiotics considering the main focus on emerging probiotic therapies for humans, livestock and aquaculture". Pritchard *et al*., (2009) "studied the use of different inventory plant extract likes*Moringa oleifera*, *Jatropha curcas* and Guar gum for the enhancement of the water quality of potable water and checked their effect on both physico-chemical and microbiological parameters such as temperature, pH, turbidity and coliforms".

Lea (2010) "studied the bioremediation techniques and they worked on the indigenous water treatment method by using *Moringa oleifera* seeds in the form of a water soluble extract in the suspension. The results were found to be efficient in reduction of the turbid surface water upto 80 to 99.5% and also accomplished the reduction in the bacterial population up to 90 to 99.99 %".

Kumar *et al*.,(2010) “carried out their study over five rivers and studied the physical, chemical and bacteriological parameters, in which they found that all the samples were *E.coli* contaminated”. Connelly *et al*.,(2012) “investigated the biosensor technology with regard to the improvements needed over standard detection methods, to enable the highly sensitive detection technique for the detection of waterborne pathogens”. Monachese *et al.,(*2012) “studied how microbial processes interact with geological and geochemical processes. They examined, the mechanisms of detoxication of lactobacilli and how itcould be helpful in the future to overcome these problems”.

Kattula *et al.,* (2015) “investigated the environmental predictors of diarrhoeal infectionamong children and adults for rural and urban communities in south India. They surveyed the households for 12-18 months and monitored the gastro-intestinal morbidity. This was the first longitudinal study in India that estimated the difference in the magnitude of diarrhoeal disease among the rural-urban communities and assessed the risk factor associated with these differences”. Kulinkina *et al.,(*2016) “studied the relationships among meteorological parameters, water quality and diarrhoeal disease counts in two urban and three rural sites in Tamil Nadu, India. Disease surveillance was conducted for two years. They found that the pipe distribution systems in the study area showed high seasonal fluctuations in water quality”.

OBJECTIVES

1. To conduct a seasonal survey and to analyze the quality of potable water of Agra, from different sources:
    i) Ground water
    ii) Municipality water supply
    iii) Packed/bottled water from unorganized sector.
    (a) Bacteriological Analysis: To check the presence of the indicator microbe, *Escherichia coli.*
    (b) Physico-Chemical Analysis: To check the physico-chemical parameters like TDS, nitrate content, pH, temperature, biological oxygen demand, dissolved oxygen and turbidity of the water samples.
2. Bioremediation of the water quality via the following:
    (a) Natural products.
    (b) Probiotics.

METHODOLOGY

Strategy for Objective: 1

To conduct a seasonal survey and to analyze the quality of potable water of Agra, from different sources: Ground water, Municipality water supply and the Packed/bottled water from unorganized sector.

The objective will be achieved by random sampling of water from the four directions (North, south, east & west) of Agra. The samples will be collected in pre-sterilized glass containers. All the samples will be kept in ice cold condition up to 4^0C until they are analyzed. The sampling will be done three times in a year for two years. Sampling will be done 3 times from each location during each season:

1. Monsoon: July-September
2. Winter: October-February
3. Summer: March-June

(a). **Bacteriological Analysis:** To check the presence of the indicator microbe, *Escherichia coli.*

The isolation and enrichment of the bacteria will be done on Eosin Methylene Blue (EMB) Agar. The identification will be initiated by biochemical characterization including tests like:

1. Methyl Red Test
2. Indole Test
3. Nitrate Test
4. Catalase Test
5. Citrate Utilization Test
6. Voges-Prokauer Test
7. Hydrogen Sulphide Test
8. Urease Test

The bacteia will be confirmed by molecular techniques like by the RAPD & 16s rRNA gene sequencing techniques (Yarza*et al.*, 2014).

(b). **Physico-Chemical Analysis:** The physico-chemical parameters like TDS, nitrate content, pH, temperature, biological oxygen demand, dissolved oxygen and turbidity of the water samples will be tested (Deshpande, 2012),and compared to the permissible limit and standards of Central Pollution Control Board of India.

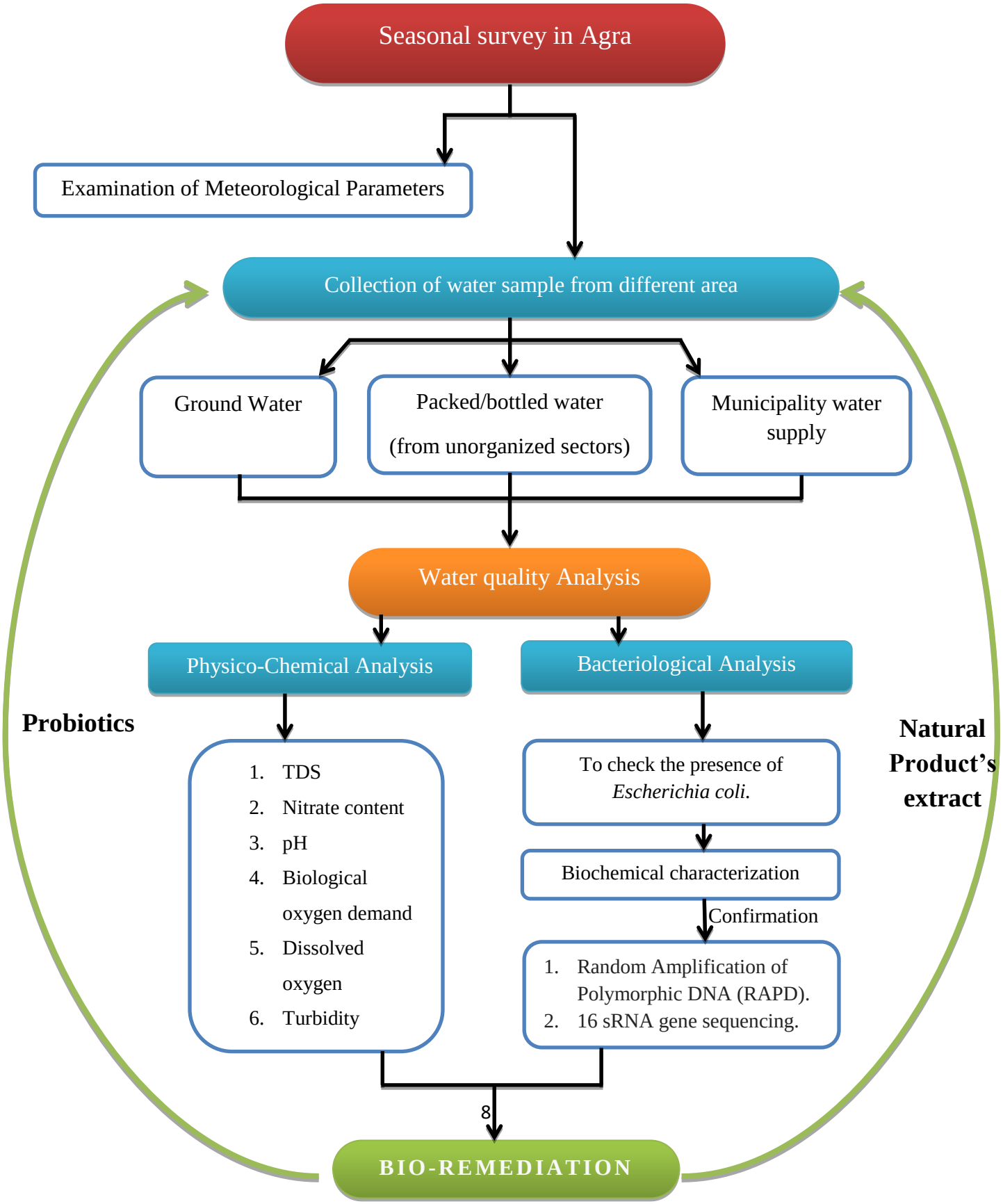
3. Strategy for Objective "2"

Bioremediation of the water quality employing the following:

(a) Extract of natural products like rose petals extract (Glick 2003), seed extract from *Moringa oleifera*(drumstick)(Lea 2010), *Cinnamonum zeylanicum*(dal chini), *Piper chabha*(choti peepal), *Terminalia belirica*(beheda), etc

(b) Probiotics like: *Lactobacillus fermentum* MTCC 903, *Lactococcus Lactis* MTCC-440, *Pediococcus acidilactici*MTCC-7742, *Lactobacillus casei* MTCC-1423 and their formulations (Gillor *et al.*,2008; Monachese *et al.*,2012) will be tested to improve the potable water quality.

WORK PLAN


Seasonal survey in Agra
Examination of Meteorological Parameters
Collection of water sample from different area
Ground Water
Packed/bottled water
(from unorganized sectors)
Municipality water supply
Water quality Analysis
Physico-Chemical Analysis
Bacteriological Analysis
Probiotics
Natural Product's extract
1. TDS
2. Nitrate content
3. pH
4. Biological oxygen demand
5. Dissolved oxygen
6. Turbidity
To check the presence of Escherichia coli.
Biochemical characterization
Confirmation
1. Random Amplification of Polymorphic DNA (RAPD).
2. 16 sRNA gene sequencing.
8
BIO-REMEDIATION

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